CLAIMS

1. A receiving apparatus that uses a maximum-likelihood-determination method as a method of determining reception data, and executes a determination process using an analog-to-digital-converted reception signal, the receiving apparatus comprising:

a transmission-path estimating unit that estimates a transmission-path response matrix of a radio transmission path based on the reception signal;

a matrix processing unit that decomposes the transmission-path response matrix into an upper triangular matrix, and multiplies the reception signal by an inverse matrix of the transmission-path response matrix;

a provisional determining unit that provisionally determines a transmission signal based on a result of multiplication of the reception signal by the inverse matrix of the transmission-path response matrix;

a metric calculating unit that calculates a metric based on a result of the provisional determination, the decomposed transmission-path response matrix, and the result of the multiplication;

an estimate-symbol determining unit that forms a hypersphere centering around a reception signal point based on either one of the metric obtained as a result of the calculation by the metric calculating unit and an updated metric, generates a candidate of an estimate symbol based on the decomposed transmission-path response matrix and the result of the multiplication, and determines whether the candidate of the estimate symbol is present within the hypersphere; and

a metric updating unit that calculates a metric based on the candidate of the estimate symbol obtained as a result of the determination by the estimate-symbol

determining unit and the result of the multiplication, stores a minimum metric from among metrics calculated in the past and the candidate of the estimate symbol corresponding to the minimum metric, compares a newly calculated metric with a currently stored metric every time when the metric is newly calculated, and updates stored information when the newly calculated metric is smaller than the currently stored metric, wherein

the metric updating unit repeats the update process until the estimate-symbol determining unit determines that no candidate of the estimate symbol is present within the hypersphere, and sets the candidate of the estimate symbol that corresponds to a final minimum metric as a maximum-likelihood-determination value.

2. The receiving apparatus according to claim 1, wherein

the estimate-symbol determining unit sets a radius of the hypersphere based on a metric notified from the metric calculating unit for a first process, and sets the radius of the hypersphere based on a metric notified from the metric updating unit for a subsequent process.

3. A receiving apparatus that uses a maximum-likelihood-determination method as a method of determining reception data, and executes a determination process using an analog-to-digital-converted reception signal, the receiving apparatus comprising:

a transmission-path estimating unit that estimates a transmission-path response matrix of a radio transmission path based on the reception signal;

a matrix processing unit that decomposes the transmission-path response matrix into an upper triangular matrix, and multiplies the reception signal by an inverse

matrix of the transmission-path response matrix;

a provisional determining unit that provisionally determines a transmission signal based on a result of multiplication of the reception signal by the inverse matrix of the transmission-path response matrix;

an estimate-symbol determining unit that forms a hypersphere centering around a reception signal point based on an updated metric, generates a candidate of an estimate symbol based on the decomposed transmission-path response matrix and the result of the multiplication, and determines whether the candidate of the estimate symbol is present within the hypersphere; and

a metric updating unit that calculates a metric based on the candidate of the estimate symbol obtained as a result of the provisional determination by the provisional determining unit or the determination by the estimate-symbol determining unit and the result of the multiplication, stores a minimum metric from among metrics calculated in the past and the candidate of the estimate symbol corresponding to the minimum metric, compares a newly calculated metric with a currently stored metric every time when the metric is newly calculated, and updates stored information when the newly calculated metric is smaller than the currently stored metric, wherein

the metric updating unit repeats the update process until when the estimate-symbol determining unit determines that no candidate of an estimate symbol is present within the hypersphere, and sets a candidate of an estimate symbol that finally corresponds to the minimum metric, as a maximum-likelihood-determination value.

4. The receiving apparatus according to claim 3, wherein the metric updating unit calculates the metric based

on the result of the provisional determination and the result of the multiplication for a first process, and calculates the metric based on the candidate of the estimate symbol obtained as the result of the determination and the result of the multiplication.

5. A receiving apparatus that uses a maximum-likelihood-determination method as a method of determining reception data, and executes a determination process using an analog-to-digital-converted reception signal, the receiving apparatus comprising:

a transmission-path estimating unit that estimates a transmission-path response matrix of a radio transmission path based on the reception signal;

a matrix processing unit that decomposes the transmission-path response matrix into an upper triangular matrix, and multiplies the reception signal by an inverse matrix of the transmission-path response matrix;

a provisional determining unit that provisionally determines a transmission signal based on a result of multiplication of the reception signal by the inverse matrix of the transmission-path response matrix;

a metric calculating unit that calculates a metric based on a result of the provisional determination, the decomposed transmission-path response matrix, and the result of the multiplication;

a comparing unit that compares a metric obtained as a result of the calculation by the metric calculating unit with an updated metric, and outputs a smaller metric;

an estimate-symbol determining unit that forms a hypersphere centering around a reception signal point based on a specific value representing a radius of the hypersphere or the updated metric, from a result of

comparison by the comparing unit, generates a candidate of an estimate symbol based on the decomposed transmission-path response matrix and the result of the multiplication, and determines whether the candidate of the estimate symbol is present within the hypersphere; and

a metric updating unit that calculates a metric based on the candidate of the estimate symbol obtained as a result of the determination by the estimate-symbol determining unit and the result of the multiplication, stores a minimum metric from among metrics calculated in the past and the candidate of the estimate symbol corresponding to the minimum metric, compares a newly calculated metric with a currently stored metric every time when the metric is newly calculated, and updates stored information when the newly calculated metric is smaller than the currently stored metric, wherein

the metric updating unit repeats the update process until the estimate-symbol determining unit determines that no candidate of the estimate symbol is present within the hypersphere, and sets the candidate of the estimate symbol that corresponds to a final minimum metric as a maximum-likelihood-determination value.

6. The receiving apparatus according to claim 5, wherein

the estimate-symbol determining unit forms the hypersphere centering around the reception signal point based on the specific value representing a radius of the hypersphere for a first process, forms the hypersphere centering around the reception signal point based on the result of the comparison for a second process, and forms the hypersphere centering around the reception signal point based on the updated metric for a subsequent process.

7. The receiving apparatus according to claim 5, wherein when M kinds of the specific values that are set based on mutually different standards are sequentially input, where M is a positive integer greater than one, the estimate-symbol determining unit forms the hypersphere centering around the reception signal point based on the input specific values for a first to M-th processes, forms the hypersphere centering around the reception signal point based on the result of the comparison for (M+1)-th process, and forms the hypersphere centering around the reception signal point based on the updated metric for a subsequent process.